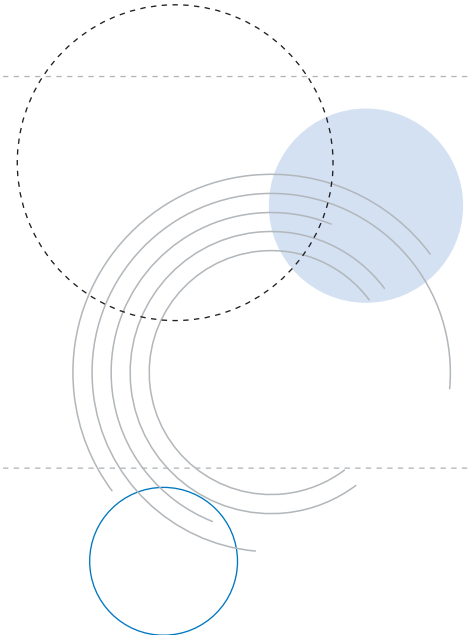

Product Manual

SV35 Series™

ST2000VX002
ST31000526SV
ST31000525SV
ST3500411SV
ST3500410SV
ST3250311SV

100562053
Rev. E
April 2011

Revision history

Revision	Date	Sheets affected or comments
Rev. A	03/06/09	Initial release.
Rev. B	07/08/09	1, 5, 7, 16, 23 and 25-26.
Rev. C	06/03/10	Updated DC power requirements.
Rev. D	01/05/11	Added new 2TB model and updated specifications.
Rev. E	04/26/11	Added updated AFR and warranty info; added AFR section. Updated words 88 and 89 in Table 10.

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When referring to hard drive capacity, one gigabyte, or GB, equals one billion bytes and one terabyte, or TB, equals one trillion bytes. Your computer's operating system may use a different standard of measurement and report a lower capacity. In addition, some of the listed capacity is used for formatting and other functions, and thus will not be available for data storage. Seagate reserves the right to change, without notice, product offerings or specifications.

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1.0 Introduction

This manual describes the functional, mechanical and interface specifications for the following Seagate SV35 Series™ model drives:

ST2000VX002	ST31000526SV	ST31000525SV
ST3500411SV	ST3500410SV	ST3250311SV

These drives provide the following key features:

- Designed with low spin-up power for optimization in surveillance applications
- Uncompromising reliability supports flexible surveillance design, with case temperatures up to 70º C
- Performance-tuned for seamless video applications
- Built-in error recovery for non-stop video streaming
- Best-in-class acoustic performance means virtually silent operation
- Higher areal density for cost-effective surveillance applications
- Enterprise-class reliability for 24x7 video surveillance applications
- Supports ATA8 streaming commands
- Enhanced caching capabilities enable superior video recording quality.
- Unique user-selectable partitioning capability
- Easy-to-use Smart Command Transport (SCT) makes management simple
- Thermal monitoring and reporting for 24x7 operations
- High instantaneous (burst) data-transfer rates.
- Perpendicular recording heads and EPRML technology, for increased areal density.
- State-of-the-art cache and on-the-fly error-correction algorithms.
- Native Command Queueing with command ordering to increase performance in demanding applications.
- Full-track multiple-sector transfer capability without local processor intervention.
- Quiet operation.
- SeaTools diagnostic software performs a drive self-test that eliminates unnecessary drive returns.
- Support for S.M.A.R.T. drive monitoring and reporting.
- Supports latching SATA cables and connectors.
- Worldwide Name (WWN) capability uniquely identifies the drive.

1.1 About the Serial ATA interface

The Serial ATA interface provides several advantages over the traditional (parallel) ATA interface. The primary advantages include:

- Easy installation and configuration with true plug-and-play connectivity. It is not necessary to set any jumpers or other configuration options.
- Thinner and more flexible cabling for improved enclosure airflow and ease of installation.
- Scalability to higher performance levels.

In addition, Serial ATA makes the transition from parallel ATA easy by providing legacy software support. Serial ATA was designed to allow you to install a Serial ATA host adapter and Serial ATA disc drive in your current system and expect all of your existing applications to work as normal.

The Serial ATA interface connects each disc drive in a point-to-point configuration with the Serial ATA host adapter. There is no master/slave relationship with Serial ATA devices like there is with parallel ATA. If two drives are attached on one Serial ATA host adapter, the host operating system views the two devices as if they were both “masters” on two separate ports. This essentially means both drives behave as if they are Device 0 (master) devices.

Note. The host adapter may, optionally, emulate a master/slave environment to host software where two devices on separate Serial ATA ports are represented to host software as a Device 0 (master) and Device 1 (slave) accessed at the same set of host bus addresses. A host adapter that emulates a master/slave environment manages two sets of shadow registers. This is not a typical Serial ATA environment.

The Serial ATA host adapter and drive share the function of emulating parallel ATA device behavior to provide backward compatibility with existing host systems and software. The Command and Control Block registers, PIO and DMA data transfers, resets, and interrupts are all emulated.

The Serial ATA host adapter contains a set of registers that shadow the contents of the traditional device registers, referred to as the Shadow Register Block. All Serial ATA devices behave like Device 0 devices. For additional information about how Serial ATA emulates parallel ATA, refer to the “Serial ATA International Organization: Serial ATA Revision 3.0”. The specification can be downloaded from www.sata-io.org.

2.0 Drive specifications

Unless otherwise noted, all specifications are measured under ambient conditions, at 25°C, and nominal power. For convenience, the phrases *the drive* and *this drive* are used throughout this manual to indicate the following drive model:

ST2000VX002	ST31000526SV	ST31000525SV
ST3500411SV	ST3500410SV	ST3250311SV

2.1 Specification summary tables

The specifications listed in the following tables are for quick reference. For details on specification measurement or definition, see the appropriate section of this manual.

Table 1: Drive specifications summary for the 2TB model

Drive specification	**ST2000VX002**
Formatted capacity (4K bytes/sector)*	2TB
Guaranteed sectors	3,907,029,168
Heads	6
Disks	3
Bytes per sector	4096 (512 bytes per sector emulated at the interface)
Default sectors per track	63
Default read/write heads	16
Default cylinders	16,383
Recording density(max)	1632kb/in
Track density (avg)	274 ktracks/in avg
Areal density (avg)	422 Gb/in^2
Internal data transfer rate (max)	1928 Mb/s max
Sustained data transfer rate (max)	144 MB/s
I/O data-transfer rate (max)	600 MB/s
ATA data-transfer modes supported	PIO modes 0–4 Multiword DMA modes 0–2 Ultra DMA modes 0–6
Cache buffer	64MB
Height (max)	26.11mm (1.028 in)
Width (max)	101.6mm (4.0 in)
Length (max)	147.00mm (5.78 in)
Weight (typical)	635 grams (1.39 lb)
Power-on to ready (max)	<17s
Track-to-track seek time	<1ms typical read; <1.2ms typical write

Table 1: Drive specifications summary for the 2TB model (continued)

Drive specification	ST2000VX002
Average seek, read	12ms
Average seek, write	13ms
Startup current (typical) 12V (peak)	2A
Voltage tolerance (including noise)	5V: ± 5% 12V: ± 10%
Operating temperature (Drive Case)	0° to 70°C
Nonoperating temperature (Drive Case)	–40° to 70°C
Temperature gradient (max)	20°C per hour max (operating) 30°C per hour max (nonoperating)
Relative humidity	5% to 90% (operating) 5% to 95% (nonoperating)
Relative humidity gradient	30% per hour max
Wet bulb temperature (max)	37.7°C max (operating) 40.0°C max (nonoperating)
Altitude, operating	–60.96 m to 3,048 m (–200 ft. to 10,000+ ft.)
Altitude, nonoperating (below mean sea level, max)	–60.96 m to 12,192 m (–200 ft. to 40,000+ ft.)
Operational Shock (max)	80 Gs at 2ms
Non-Operational Shock (max)	300 Gs at 2ms
Vibration, operating	5Hz-22Hz: 0.25 Gs, Limited displacement 22Hz-350Hz: 0.50 Gs 350Hz-500 Hz: 0.25 Gs
Vibration, nonoperating	5Hz-22Hz: 2.0 Gs, Limited displacement 22Hz-350Hz: 5.0 Gs 350Hz-500Hz: 2.0 Gs
Drive acoustics, sound power	
Idle**	2.1 bels (typical) 2.3 bels (max)
Seek	2.3 bels (typical) 2.4 bels (max)
Nonrecoverable read errors	1 per 10^{14} bits read
Annualized Failure Rate (AFR)	<1%
Warranty	To determine the warranty for a specific drive, use a web browser to access the following web page: support.seagate.com/customer/warranty_validation.jsp From this page, click on the “Verify Your Warranty” link. You will be asked to provide the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for your drive. Preventative maintenance: none required.
Load/ unload cycles (25°C, 50% Humidity)	300,000
Supports Hotplug operation per the Serial ATA Revision 3.0 specification	Yes

*One Gbyte equals one billion bytes when referring to hard drive capacity. Accessible capacity may vary depending on operating environment and formatting.
**During periods of drive idle, some offline activity may occur according to the S.M.A.R.T. specification, which may increase acoustic and power to operational levels.

Table 2: Drive specifications summary for the 1TB models

Drive specification	ST31000526SV	ST31000525SV
Formatted capacity (512 bytes/sector)*	1TB	1TB
Guaranteed sectors	1,953,525,168	1,953,525,168
Heads	4	4
Disks	2	2
Bytes per sector	512	512
Default sectors per track	63	63
Default read/write heads	16	16
Default cylinders	16,383	16,383
Recording density(max)	1474 kb/in	1474 kb/in
Track density (avg)	236 ktracks/in	236 ktracks/in
Areal density (avg)	345 Gb/in^2	345 Gb/in^2
Internal data transfer rate (max)	1628 Mb/s	1628 Mb/s
Sustained data transfer rate (max)	140 MB/s	140 MB/s
I/O data-transfer rate (max)	600 MB/s	300 MB/s
ATA data-transfer modes supported	PIO modes 0–4 Multiword DMA modes 0–2 Ultra DMA modes 0–6	
Cache buffer	32MB	32MB
Height (max)	26.11mm (1.028 in)	26.11mm (1.028 in)
Width (max)	101.6mm (4.0 in)	101.85mm (4.010 in)
Length (max)	146.99mm (5.787 in)	146.99mm (5.787 in)
Weight (typical)	677g (1.493 lb)	677g (1.493 lb)
Power-on to ready(max)	<10s	<10s
Track-to-track seek time	<1.0ms (typical read) <1.2ms (typical write)	<1.0ms (typical read) <1.2ms (typical write)
Average seek, read (typical)	<12ms	<12ms
Average seek, write (typical)	<13ms	<13ms
Startup current (typical) 12V (peak)	2.0A	2.0A
Voltage tolerance (including noise)	5V ± 5% 12V ± 10%	5V ± 5% 12V ± 10%
Operating temperature (Drive Case)	0° to 70°C	0° to 70°C
Nonoperating temperature (Drive Case)	–40° to 70°C	–40° to 70°C
Temperature gradient (max)	20°C per hour max (operating) 30°C per hour max (nonoperating)	20°C per hour max (operating) 30°C per hour max (nonoperating)
Relative humidity	5% to 90% (operating) 5% to 95% (nonoperating)	5% to 90% (operating) 5% to 95% (nonoperating)
Relative humidity gradient (max)	30% per hour	30% per hour
Wet bulb temperature (max)	37.7°C (operating) 40.0°C (nonoperating)	37.7°C (operating) 40.0°C (nonoperating)
Altitude, operating	–60.96m to 3,048m (–200 ft. to 10,000+ ft.)	–60.96m to 3,048m (–200 ft. to 10,000+ ft.)
Altitude, nonoperating (below mean sea level, max)	–60.96 m to 12,192 m (–200 ft. to 40,000+ ft.)	–60.96 m to 12,192 m (–200 ft. to 40,000+ ft.)
Operational Shock (max)	63 Gs at 2ms	63 Gs at 2ms
Non-Operational Shock (max)	300 Gs at 2ms	300 Gs at 2ms

Table 2: Drive specifications summary for the 1TB models (continued)

Drive specification	ST31000526SV	ST31000525SV
Vibration, operating	5Hz-22Hz: 0.25 Gs, Limited displacement 22Hz-350Hz: 0.50 Gs 350Hz-500Hz: 0.25 Gs	5Hz-22 Hz: 0.25 Gs, Limited displacement 22Hz-350 Hz: 0.50 Gs 350Hz-500Hz: 0.25 Gs
Vibration, nonoperating	5Hz-22Hz: 2.0 Gs, Limited displacement 22Hz-350Hz: 5.0 Gs 350Hz-500Hz: 2.0 Gs	5Hz-22Hz: 2.0 Gs, Limited displacement 22Hz-350Hz: 5.0 Gs 350Hz-500Hz: 2.0 Gs
Drive acoustics, sound power		
Idle**	2.7 bels (typical) 2.9 bels (max)	2.7 bels (typical) 2.9 bels (max)
Seek	2.8 bels (typical) 3.0 bels (max)	2.8 bels (typical) 3.0 bels (max)
Nonrecoverable read errors	1 per 10^{14} bits read	1 per 10^{14} bits read
Annualized Failure Rate (AFR)	<1%	<1%
Warranty	To determine the warranty for a specific drive, use a web browser to access the following web page: www.seagate.com/support/service/ From this page, click on the "Verify Your Warranty" link. You will be asked to provide the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for your drive. Preventative maintenance: none required.	
Contact start-stop cycles	50,000 at 25°C, 50% rel. humidity	50,000 at 25°C, 50% rel. humidity
Supports Hotplug operation per the Serial ATA Revision 3.0 specification	Yes	Yes

*One Gbyte equals one billion bytes when referring to hard drive capacity. Accessible capacity may vary depending on operating environment and formatting.
**During periods of drive idle, some offline activity may occur according to the S.M.A.R.T. specification, which may increase acoustic and power to operational levels.

Table 3: Drive specifications summary for 500GB and 250GB models

Drive specification	ST3500411SV	ST3500410SV	ST3250311SV
Formatted capacity (512 bytes/sector)*	500GB	500GB	250GB
Guaranteed sectors	976,773,168	976,773,168	488,397,168
Heads	2	2	1
Disks	1	1	
Bytes per sector	512	512	512
Default sectors per track	63	63	63
Default read/write heads	16	16	16
Default cylinders	16,383	16,383	16,383
Recording density (max)	1474 kb/in	1474 kb/in	1474 kb/in
Track density (avg)	236 ktracks/in	236 ktracks/in	236 ktracks/in
Areal density (avg)	345 Gbits/in^2	345 Gbits/in^2	345 Gbits/in^2
Internal data transfer rate (max)	1628 Mbits/s	1628 Mbits/s	1628 Mbits/s
Sustained data transfer rate (max)	140 MB/s	140 MB/s	140 MB/s
I/O data-transfer rate (max)	600 MB/s	300 MB/s	300 MB/s
ATA data-transfer modes supported	PIO modes 0–4 Multiword DMA modes 0–2 Ultra DMA modes 0–6		
Cache buffer	16MB	16MB	8MB
Height (max)	19.98mm (0.787 in)	19.98mm (0.787 in)	20.20mm (0.794 in)
Width (max)	101.6mm (4.0 in)	101.85mm (4.010 in)	101.85mm (4.010 in)
Length (max)	146.99 mm (5.787 in)	146.99 mm (5.787 in)	146.99mm (5.787 in)
Weight (typical)	544 grams (1.199 lb.)	544 grams (1.199 lb)	380 grams (0.838 lb)

Table 3: Drive specifications summary for 500GB and 250GB models (continued)

Drive specification	ST3500411SV	ST3500410SV	ST3250311SV
Power-on to ready (max)	<10s	<10s	<8s
Track-to-track seek time	<0.5ms typical read; <1.5ms typical write	<0.5 msec typical read; <1.5 msec typical write	<1.0 msec typical read; <1.2 msec typical write
Average seek, read	<8.5ms typical	<8.5 msec typical	<8.5 msec typical
Average seek, write	<9.5ms typical	<9.5 msec typical	<9.5 msec typical
Startup current (typical) 12V (peak)	2.0A	2.0A	2.0A
Voltage tolerance (including noise)	5V ± 5% 12V ± 10%	5V ± 5% 12V ± 10%	5V ± 5% 12V ± 10%
Operating temperature (Drive Case)	0° to 70°C	0° to 70°C	0° to 70°C
Nonoperating temperature (Drive Case)	–40° to 70°C	–40° to 70°C	–40° to 70°C
Temperature gradient (max)	20°C per hour max (operating) 30°C per hour max (nonoperating)	20°C per hour max (operating) 30°C per hour max (nonoperating)	20°C per hour max (operating) 30°C per hour max (nonoperating)
Relative humidity	5% to 90% (operating) 5% to 95% (nonoperating)	5% to 90% (operating) 5% to 95% (nonoperating)	5% to 90% (operating) 5% to 95% (nonoperating)
Relative humidity gradient	30% per hour max	30% per hour max	30% per hour max
Wet bulb temperature (max)	37.7°C (operating) 40.0°C (nonoperating)	37.7°C (operating) 40.0°C (nonoperating)	37.7°C (operating) 40.0°C (nonoperating)
Altitude, operating	–60.96m to 3,048 m (–200 ft. to 10,000+ ft.)	–60.96m to 3,048 m (–200 ft. to 10,000+ ft.)	–60.96m to 3,048m (–200 ft. to 10,000+ ft.)
Altitude, nonoperating (below mean sea level, max)	–60.96m to 12,192m (–200 ft. to 40,000+ ft.)	–60.96m to 12,192m (–200 ft. to 40,000+ ft.)	–60.96m to 12,192m (–200 ft. to 40,000+ ft.)
Operational Shock	63 Gs at 2ms	63 Gs at 2ms	63 Gs at 2ms
Non-Operational Shock (max)	300 Gs at 2ms	300 Gs at 2ms	350 Gs at 2ms
Vibration, operating	5Hz-22Hz: 3.0 Gs, Limited displacement 22Hz-350Hz: 3.0 Gs 350Hz-500Hz: 3.0 Gs	5-22Hz: 3.0 Gs, Limited displacement 22Hz-350Hz: 3.0 Gs 350Hz-500Hz: 3.0 Gs	5Hz-22Hz: 3.0 Gs, Limited displacement 22Hz-350Hz: 3.0 Gs 350Hz-500Hz: 3.0 Gs
Vibration, nonoperating	5Hz-22Hz: 2.0 Gs, Limited displacement 22Hz-350Hz: 5.0 Gs 350Hz-500Hz: 2.0 Gs	5Hz-22Hz: 2.0 Gs, Limited displacement 22Hz-350Hz: 5.0 Gs 350Hz-500Hz: 2.0 Gs	5Hz-350Hz: 5.0 Gs 350Hz-500Hz: 1.0 Gs
Drive acoustics, sound power			
Idle**	2.7 bels (typical) 2.9 bels (max)	2.7 bels (typical) 2.9 bels (max)	2.5 bels (typical) 2.8 bels (max)
Seek	2.8 bels (typical) 3.0 bels (max)	2.8 bels (typical) 3.0 bels (max)	2.6 bels (typical) 2.8 bels (max)
Nonrecoverable read errors	1 per 10^{14} bits read	1 per 10^{14} bits read	1 per 10^{14} bits read
Annualized Failure Rate (AFR)	<1%	<1%	<1%
Warranty	To determine the warranty for a specific drive, use a web browser to access the following web page: www.seagate.com/support/service/ From this page, click on the "Verify Your Warranty" link. You will be asked to provide the drive serial number, model number (or part number) and country of purchase. The system will display the warranty information for your drive. Preventative maintenance: none required.		
Contact start-stop cycles	50,000 at 25°C, 50% rel. humidity	50,000 at 25°C, 50% rel. humidity	50,000 at 25°C, 50% rel. humidity
Supports Hotplug operation per the Serial ATA Revision 3.0 specification	Yes	Yes	Yes

*One Gbyte equals one billion bytes when referring to hard drive capacity. Accessible capacity may vary depending on operating environment and formatting.
**During periods of drive idle, some offline activity may occur according to the S.M.A.R.T. specification, which may increase acoustic and power to operational levels.

2.2 Formatted capacity

Model	Formatted capacity*	Guaranteed sectors	Bytes per sector
ST2000VX002	2TB	3,907,029,168	4096 (512 bytes per sector emulated at the interface)
ST31000526SV	1TB	1,953,525,168	512
ST31000525SV			
ST3500411SV	500GB	976,773,168	
ST3500410SV			
ST3250311SV	250GB	488,397,168	

*One Gbyte equals one billion bytes when referring to hard drive capacity. Accessible capacity may vary depending on operating environment and formatting.

2.2.1 LBA mode

When addressing the drive in LBA mode, all blocks (sectors) are consecutively numbered from 0 to *n–1,* where *n* is the number of guaranteed sectors as defined above.

See Section 4.3.1, "Identify Device command" (words 60-61 and 100-103) for additional information about 48-bit addressing support of drives with capacities over 137 Gbytes.

2.3 Default logical geometry

Cylinders	Read/write heads	Sectors per track
16,383	16	63

LBA mode
When addressing the drive in LBA mode, all blocks (sectors) are consecutively numbered from 0 to *n–1,* where *n* is the number of guaranteed sectors as defined above.

2.4 Recording and interface technology

	ST2000VX002	**ST31000526SV, ST31000525SV, ST3500411SV, ST3500410SV, ST3250311SV**
Interface	Serial ATA (SATA)	Serial ATA (SATA)
Recording method	Perpendicular	Perpendicular
Recording density- kb/in (max)	1632kb/in	1,474 kbits/in max
Track density- ktracks/in (avg)	274 ktracks/in avg	236 ktracks/in avg
Areal density- Gb/in^2 (avg)	422 Gb/in^2	345 Gbits/in^2 avg
Internal data transfer rate	1928 Mb/s max	1628 Mbits/sec max
Sustained data transfer rate (max)	144	140
I/O data-transfer rate (max)	600	300

2.5 Physical characteristics

	2TB model	1TB models	500GB models	250GB model
Maximum height	26.1mm (1.028 in)	26.1mm (1.028 in)	19.98mm (0.787 in)	20.20 mm (0.794 in)
Maximum width	101.6mm (4.0 in)	101.85mm (4.010 in)	101.85mm (4.010 in)	101.85mm (4.010 in)
Maximum length	147.00mm (5.78 in)	146.99mm (5.787 in)	146.99mm (5.787 in)	146.99mm (5.787 in)
Typical weight	635g (1.39 lb)	677g (1.493 lb)	544 grams (1.199 lb)	380 grams (0.838 lb)
Cache buffer	64MB	32MB	16MB	16MB

2.6 Seek time

Seek measurements are taken with nominal power at 25°C ambient temperature. All times are measured using drive diagnostics. The specifications in the table below are defined as follows:

- Track-to-track seek time is an average of all possible single-track seeks in both directions.
- Average seek time is a true statistical random average of at least 5,000 measurements of seeks between random tracks, less overhead.

	2TB model		1TB and 500GB model		250GB models	
Typical seek times (msec)*	**Read**	**Write**	**Read**	**Write**	**Read**	**Write**
Track-to-track	<0.5	<1.5	<0.5	<1.5	<1.0	<1.2
Average	<8.5	<9.5	<8.5	<9.5	<8.5	<9.0

*Measured in Seek mode.

Note. These drives are designed to consistently meet the seek times represented in this manual. Physical seeks, regardless of mode (such as track-to-track and average), are expected to meet the noted values. However, due to the manner in which these drives are formatted, benchmark tests that include command overhead or measure logical seeks may produce results that vary from these specifications.

2.7 Start/stop times

	2TB model	1TB and 500GB models	250GB models
Power-on to Ready (max)	<17s	<10s	<8s
Ready to spindle stop (max)	10s	12s	12s

Note. Start/stop measurements are taken with nominal power at 25°C ambient temperature.

2.8 Power specifications

The drive receives DC power (+5V or +12V) through a native SATA power connector. See Figure 3 on page 22.

2.8.1 Power consumption and DC power requirements

Power requirements for the drives are listed in the table on page 9. Typical power measurements are based on an average of drives tested, under nominal conditions, using 5.0V and 12.0V input voltage at 25°C ambient temperature.

- **Spinup power**
  Spinup power is measured from the time of power-on to the time that the drive spindle reaches operating speed.
- **Idle mode power**
  Idle mode power is measured with the drive up to speed, with servo electronics active and with the heads in a random track location.
- **Operating**
  Operating power is measured by simulating a typical PVR operating environment, using a 50% write 50% read algorithm.
- **Standby mode**
  During Standby mode, the drive accepts commands, but the drive is not spinning, and the servo and read/write electronics are in power-down mode.

Table 4: DC power requirements (3-disk, 2TB)

Power dissipation (4-disk values shown)	Avg (watts 25° C)	Avg 5V typ amps	Avg 12V typ amps
Spinup	—	—	2.0 (peak)
Idle*†	5.0	0.168	0.337
Idle*† (with offline activity)	5.40	0.153	0.387
Operating	5.8	0.496	0.341
Standby	0.5	0.35	0.01
Sleep	0.5	0.35	0.01

Table 5: DC power requirements (1 and 2-disk, 1TB and 500GB)

Power dissipation (3-disk values shown)	Avg (watts 25° C)	Avg 5V typ amps	Avg 12V typ amps
Spinup	—	—	2.0 (peak)
Idle*†	5.0	0.168	0.337
Idle*† (with offline activity)	5.40	0.153	0.387
Operating	7.0	0.496	0.341
Standby	1.0	0.35	0.01
Sleep	1.0	0.35	0.01

*During periods of drive idle, some offline activity may occur according to the S.M.A.R.T. specification, which may increase acoustic and power to operational levels.

†5W IDLE with DIPLM Enabled

Figure 1. ***Typical Current Profiles (5V)***

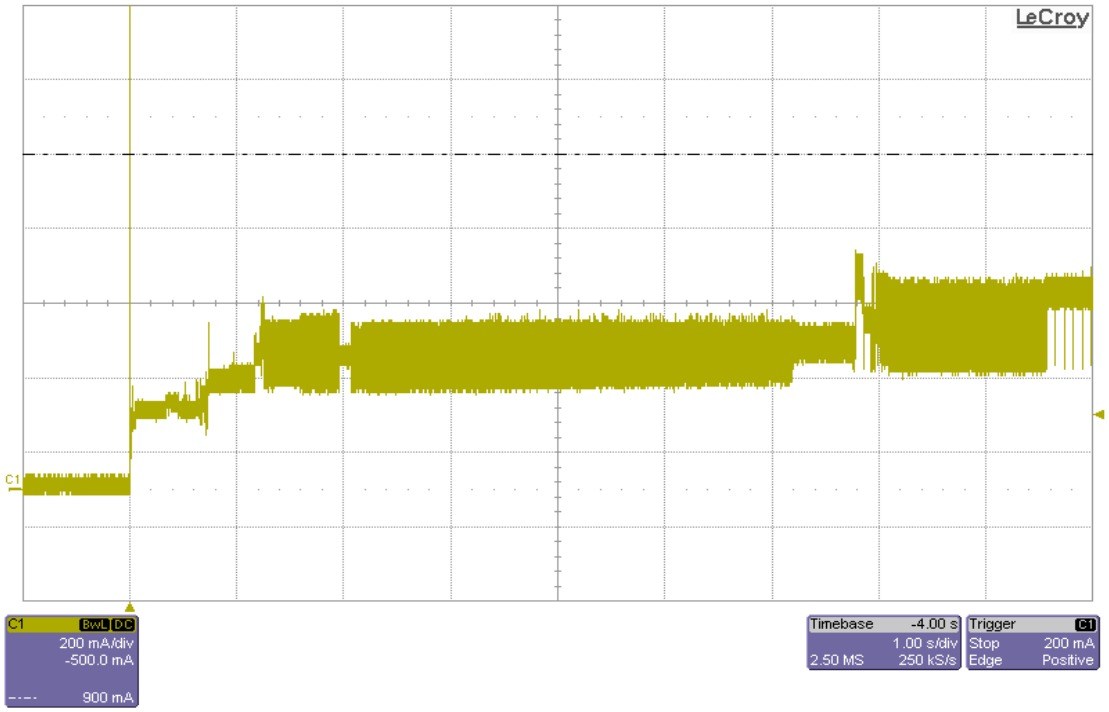
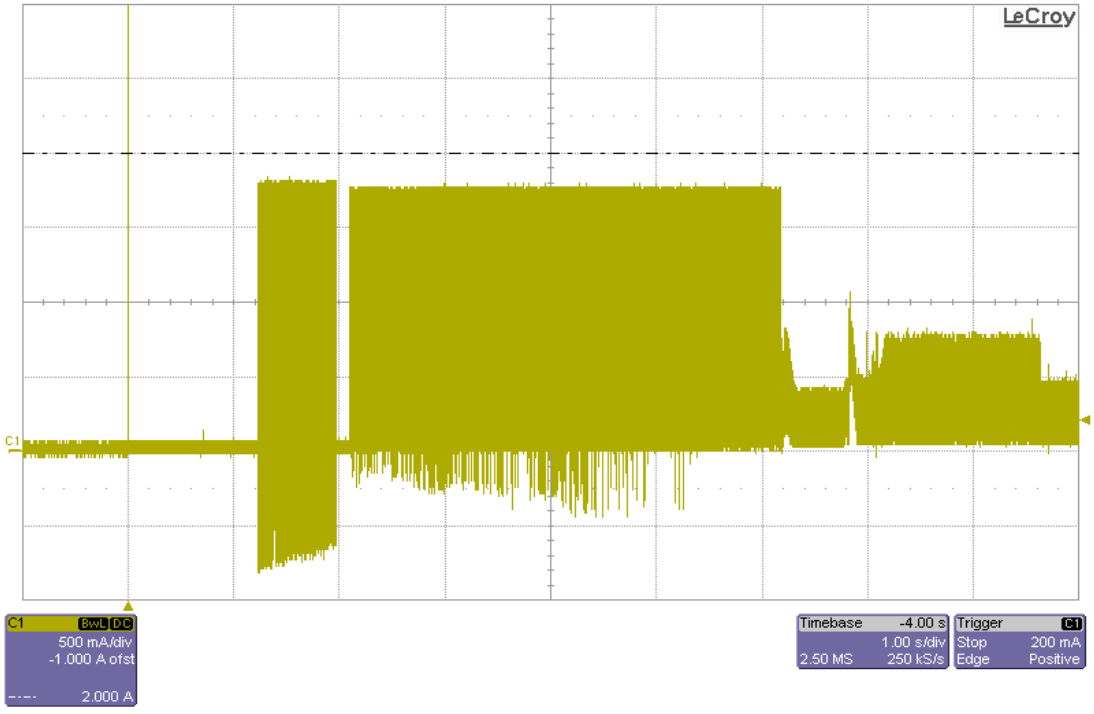


Figure 2. ***Typical Current Profiles (12V)***



2.8.2 Conducted noise

Input noise ripple is measured at the host system power supply across an equivalent 80-ohm resistive load on the +12 volt line or an equivalent 15-ohm resistive load on the +5 volt line.

- Using 12-volt power, the drive is expected to operate with a maximum of 120 mV peak-to-peak square-wave injected noise at up to 10MHz.
- Using 5-volt power, the drive is expected to operate with a maximum of 100 mV peak-to-peak square-wave injected noise at up to 10MHz.

Note. Equivalent resistance is calculated by dividing the nominal voltage by the typical RMS read/write current.

2.8.3 Power-management modes

The drive provides programmable power management to provide greater energy efficiency. In most systems, you can control power management through the system setup program. The drive features the following power-management modes:

Power modes	Heads	Spindle	Buffer
Active	Tracking	Rotating	Enabled
Idle	Tracking	Rotating	Enable
Standby	Parked	Stopped	Enabled
Sleep	Parked	Stopped	Disabled

- **Active mode**

  The drive is in Active mode during the read/write and seek operations.

- **Idle mode**

  The buffer remains enabled, and the drive accepts all commands and returns to Active mode any time disc access is necessary.

- **Standby mode**

  The drive enters Standby mode when the host sends a Standby Immediate command. If the host has set the standby timer, the drive can also enter Standby mode automatically after the drive has been inactive for a specifiable length of time. The standby timer delay is established using a Standby or Idle command. In Standby mode, the drive buffer is enabled, the heads are parked and the spindle is at rest. The drive accepts all commands and returns to Active mode any time disc access is necessary.

- **Sleep mode**

  The drive enters Sleep mode after receiving a Sleep command from the host. In Sleep mode, the drive buffer is disabled, the heads are parked and the spindle is at rest. The drive leaves Sleep mode after it receives a Hard Reset or Soft Reset from the host. After receiving a reset, the drive exits Sleep mode and enters Standby mode with all current translation parameters intact.

- **Idle and Standby timers**

  Each time the drive performs an Active function (read, write or seek), the standby timer is reinitialized and begins counting down from its specified delay times to zero. If the standby timer reaches zero before any drive activity is required, the drive makes a transition to Standby mode. In both Idle and Standby mode, the drive accepts all commands and returns to Active mode when disc access is necessary.

2.9 Environmental specifications

2.9.1 Drive case temperature

Above 1,000 feet (305 meters), the maximum temperature is derated linearly to 112°F (44°C) at 10,000 feet (3,048 meters).

Drive case temperature should be measured at the location indicated in Figure 4 on page 23.

Operating (Drive case temperature)	0° to 70°C (32° to 158°F)
Nonoperating (Drive case temperature)	–40° to 70°C (–40° to 158°F)

2.9.2 Temperature gradient

Operating:	20°C per hour (68°F per hour max), without condensation
Nonoperating:	30°C per hour (86°F per hour max)

2.9.3 Humidity

2.9.3.1 Relative humidity

Operating:	5% to 90% noncondensing (30% per hour max)
Nonoperating:	5% to 95% noncondensing (30% per hour max)

2.9.3.2 Wet bulb temperature

Operating:	37.7°C (99.9°F max)
Nonoperating:	40.0°C (104°F max)

2.9.4 Altitude

Operating:	–60.96 m to 3,048 m (–200 ft. to 10,000+ ft.)
Nonoperating:	–60.96 m to 12,192 m (–200 ft. to 40,000+ ft.)

2.9.5 Shock

All shock specifications assume that the drive is mounted securely with the input shock applied at the drive mounting screws. Shock may be applied in the X, Y or Z axis.

2.9.5.1 Operating shock

The drives comply with the performance levels specified in this document when subjected to a maximum operating shock of 63 Gs based on half-sine shock pulses of 2 milliseconds. Shocks should not be repeated more than two times per second. For the 2TB model, the maximum operating shock is 80 Gs based on a half-sine shock pulses of 2 milleseconds.

2.9.5.2 Nonoperating shock

2/3 disk models

The nonoperating shock level that the drive can experience without incurring physical damage or degradation in performance when subsequently put into operation is 300 Gs based on a nonrepetitive half-sine shock pulse of 2 msec duration.

1 disk models

The nonoperating shock level that the drive can experience without incurring physical damage or degradation in performance when subsequently put into operation is 350 Gs based on a nonrepetitive half-sine shock pulse of 2 msec duration.

2.9.6 Vibration

All vibration specifications assume that the drive is mounted securely with the input vibration applied at the drive mounting screws. Vibration may be applied in the X, Y or Z axis.

2.9.6.1 Operating vibration

The maximum vibration levels that the drive may experience while meeting the performance standards specified in this document are specified below.

3-disk model

5Hz–22Hz	3.0 Gs (Limited displacement)
22Hz–350Hz	3.0 Gs
350Hz–500Hz	3.0 Gs

2/1-disk models

5Hz–22Hz	0.25 Gs (Limited displacement)
22Hz–350Hz	0.50 Gs
350Hz–500Hz	0.25 Gs

2.9.6.2 Nonoperating vibration

The maximum nonoperating vibration levels that the drive may experience without incurring physical damage or degradation in performance when subsequently put into operation are specified below.

2TB model

5Hz–22Hz	0.25 Gs (Limited displacement)
22Hz–350Hz	5.0 Gs
350Hz–500Hz	2.0 Gs

1TB and 500GB models

5Hz–22Hz	0.25 Gs (Limited displacement)
22Hz–350Hz	5.0 Gs
350Hz–500Hz	2.0 Gs

250GB models

5Hz–350Hz	5.0 Gs
350Hz–500Hz	1.0 Gs

2.10 Acoustics emissions

Drive emission of sound is measured consistent with the ECMA-74 and its referenced standards. Testing is conducted at room temperature (approximately 25 degrees C). Emission levels are reported as the total A-weighted sound power levels for, steady state, idle and active (seek) modes of operations.

Table 6: Drive A-weighted Sound Power Levels (SWL, BA)

	Idle[1]	Seek
2000 GB	2.1 bels (typ) 2.3 bels (max)	2.3 bels (typ) 2.4 bels (max)
1000GB and 500GB models	2.7 bels (typ) 2.9 bels (max)	2.8 bels (typ) 3.0 bels (max)
250 GB model	2.5 bels (typ) 2.8 bels (max)	2.6 bels (typ) 2.8 bels (max)

[1] During periods of drive idle, some offline activity may occur according to the S.M.A.R.T. specification, which may increase acoustic and power to operational levels.

Test for Prominent Discrete Tones (PDTs)

Seagate follows the ECMA-74 standards for measurement and identification of PDTs. An exception to this process is the use of the absolute threshold of hearing. Seagate uses the lower limit for the threshold curve* to discern tone audibility and to compensate for the inaudible components of sound prior to computation of tone ratios according to Annex D of the ECMA-74 standards.

* Defined as the median curve given by ISO 389-7 (Tf curve) minus 10dB at all frequencies.

2.11 Electromagnetic immunity

When properly installed in a representative host system, the drive operates without errors or degradation in performance when subjected to the radio frequency (RF) environments defined in the following table:

Table 7: Radio frequency environments

Test	Description	Performance level	Reference standard
Electrostatic discharge	Contact, HCP, VCP: ± 4 kV; Air: ± 8 kV	B	EN 61000-4-2: 95
Radiated RF immunity	80 to 1000MHz, 3 V/m, 80% AM with 1kHz sine 900MHz, 3 V/m, 50% pulse modulation @ 200Hz	A	EN 61000-4-3: 96 ENV 50204: 95
Electrical fast transient	± 1kV on AC mains, ± 0.5 kV on external I/O	B	EN 61000-4-4: 95
Surge immunity	± 1kV differential, ± 2 kV common, AC mains	B	EN 61000-4-5: 95
Conducted RF immunity	150kHz to 80MHz, 3 Vrms, 80% AM with 1kHz sine	A	EN 61000-4-6: 97
Voltage dips, interrupts	0% open, 5 seconds 0% short, 5 seconds 40%, 0.10 seconds 70%, 0.01 seconds	C C C B	EN 61000-4-11: 94

2.12 Reliability - Annualized Failure Rate

The product will achieve an Annualized Failure Rate (AFR) of <1% when operated in an environment of ambient air temperatures of 25°C. Operation at temperatures outside the specifications shown in **Section 2.9** may increase the product AFR. AFR is a population statistics that is not relevant to individual units.

- AFR specifications are based on the following assumptions for consumer electronics environments:
- 8760 power-on-hours per year
- 10,000 average motor start/stop cycles per year
- Operations at nominal voltages
- Temperatures outside the specifications in **Section 2.9** may reduce the product reliability.
- Normal I/O duty cycle for consumer electronics environments. Operation at excessive I/O duty cycle may degrade product reliability.

The consumer electronics environment of power-on-hours, temperature, and I/O duty cycle affect the product AFR. The AFR will be degraded if used in an enterprise application.

2.13 Warranty

To determine the warranty for a specific drive, use a web browser to access the following web page:
support.seagate.com/customer/warranty_validation.jsp

From this page, click on the “Verify Your Warranty” link. You will be asked to provide the drive serial number, model number(or part number) and country of purchase. The system will display the warranty information for your drive. Preventative maintenance: none required.

2.14 Agency certification

2.14.1 Safety certification

These products are certified to meet the requirements of UL60950-1, CSA60950-1 and EN60950 and so marked as to the certify agency.

2.14.2 Electromagnetic compatibility

Hard drives that display the CE mark comply with the European Union (EU) requirements specified in the Electromagnetic Compatibility Directive (2004/108/EC) as put into place 20 July 2007. Testing is performed to the levels specified by the product standards for Information Technology Equipment (ITE). Emission levels are defined by EN 55022, Class B and the immunity levels are defined by EN 55024.

Drives are tested in representative end-user systems. Although CE-marked Seagate drives comply with the directives when used in the test systems, we cannot guarantee that all systems will comply with the directives. The drive is designed for operation inside a properly designed enclosure, with properly shielded I/O cable (if necessary) and terminators on all unused I/O ports. Computer manufacturers and system integrators should confirm EMC compliance and provide CE marking for their products.

Korean RRL

If these drives have the Korean Communications Commission (KCC) logo, they comply with paragraph 1 of Article 11 of the Electromagnetic Compatibility control Regulation and meet the Electromagnetic Compatibility (EMC) Framework requirements of the Radio Research Laboratory (RRL) Communications Commission, Republic of Korea.

These drives have been tested and comply with the Electromagnetic Interference/Electromagnetic Susceptibility (EMI/EMS) for Class B products. Drives are tested in a representative, end-user system by a Korean-recognized lab.

- Family name: SV35.5 Series
- Certificate number: STX-720012 (B)

Australian C-Tick (N176)

If these models have the C-Tick marking, they comply with the Australia/New Zealand Standard AS/NZ CISPR22 and meet the Electromagnetic Compatibility (EMC) Framework requirements of the Australian Communication Authority (ACA).

2.14.3 FCC verification

These drives are intended to be contained solely within a personal computer or similar enclosure (not attached as an external device). As such, each drive is considered to be a subassembly even when it is individually marketed to the customer. As a subassembly, no Federal Communications Commission verification or certification of the device is required.

Seagate has tested this device in enclosures as described above to ensure that the total assembly (enclosure, disc drive, motherboard, power supply, etc.) does comply with the limits for a Class B computing device, pursuant to Subpart J, Part 15 of the FCC rules. Operation with noncertified assemblies is likely to result in interference to radio and television reception.

Radio and television interference. This equipment generates and uses radio frequency energy and if not installed and used in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception.

This equipment is designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does

cause interference to radio or television, which can be determined by turning the equipment on and off, you are encouraged to try one or more of the following corrective measures:

- Reorient the receiving antenna.
- Move the device to one side or the other of the radio or TV.
- Move the device farther away from the radio or TV.
- Plug the computer into a different outlet so that the receiver and computer are on different branch outlets.

If necessary, you should consult your dealer or an experienced radio/television technician for additional suggestions. You may find helpful the following booklet prepared by the Federal Communications Commission: *How to Identify and Resolve Radio-Television Interference Problems*. This booklet is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Refer to publication number 004-000-00345-4.

2.15 Environmental protection

Seagate designs its products to meet environmental protection requirements worldwide, including regulations restricting certain chemical substances.

2.15.1 European Union Restriction of Hazardous Substances (RoHS) Directive

The European Union Restriction of Hazardous Substances (RoHS) Directive, restricts the presence of chemical substances, including Lead, Cadmium, Mercury, Hexavalent Chromium, PBB and PBDE, in electronic products, effective July 2006. This drive is manufactured with components and materials that comply with the RoHS Directive.

2.15.2 China Restriction of Hazardous Substances (RoHS) Directive 中国限制危险物品的指令

This product has an Environmental Protection Use Period (EPUP) of 20 years. The following table contains information mandated by China's "Marking Requirements for Control of Pollution Caused by Electronic Information Products" Standard.

该产品具有20年的环境保护使用周期 （EPUP）。 下表包含了中国 “电子产品所导致的污染的控制的记号要求”所指定的信息。

Name of Parts 部件名称	Toxic or Hazardous Substances or Elements有毒有害物质或元素					
	Lead 铅 （Pb）	Mercury 汞 （Hg）	Cadmium 镉 （Cd）	Hexavalent Chromium 六价铬 （Cr6+）	Polybrominated Biphenyl 多溴联苯 （PBB）	Polybrominated Diphenyl Ether 多溴二苯醚 （PBDE）
PCBA	X	O	O	O	O	O
HDA	X	O	O	O	O	O

"O" indicates the hazardous and toxic substance content of the part (at the homogenous material level) is lower than the threshold defined by the China RoHS MCV Standard.

“O”表示该部件（于同类物品程度上）所含的危险和有毒物质低于中国RoHS MCV标准所定义的门槛值。

"X" indicates the hazardous and toxic substance content of the part (at the homogenous material level) is over the threshold defined by the China RoHS MCV Standard.

“X”表示该部件（于同类物品程度上）所含的危险和有毒物质超出中国RoHS MCV标准所定义的门槛值。

2.16 Corrosive environment

Seagate electronic drive components pass accelerated corrosion testing equivalent to 10 years exposure to light industrial environments containing sulfurous gases, chlorine and nitric oxide, classes G and H per ASTM B845. However, this accelerated testing cannot duplicate every potential application environment. Users should use caution exposing any electronic components to uncontrolled chemical pollutants and corrosive chemicals as electronic drive component reliability can be affected by the installation environment. The silver, copper, nickel and gold films used in Seagate products are especially sensitive to the presence of sulfide, chloride, and nitrate contaminants. Sulfur is found to be the most damaging. In addition, electronic components should never be exposed to condensing water on the surface of the printed circuit board assembly (PCBA) or exposed to an ambient relative humidity greater than 95%. Materials used in cabinet fabrication, such as vulcanized rubber, that can outgas corrosive compounds should be minimized or eliminated. The useful life of any electronic equipment may be extended by replacing materials near circuitry with sulfide-free alternatives.

3.0 Configuring and mounting the drive

This section contains the specifications and instructions for configuring and mounting the drive.

3.1 Handling and static-discharge precautions

After unpacking, and before installation, the drive may be exposed to potential handling and electrostatic discharge (ESD) hazards. Observe the following standard handling and static-discharge precautions:

Caution:

- Before handling the drive, put on a grounded wrist strap, or ground yourself frequently by touching the metal chassis of a computer that is plugged into a grounded outlet. Wear a grounded wrist strap throughout the entire installation procedure.
- Handle the drive by its edges or frame *only*.
- The drive is extremely fragile—handle it with care. Do not press down on the drive top cover.
- Always rest the drive on a padded, antistatic surface until you mount it in the computer.
- Do not touch the connector pins or the printed circuit board.
- Do not remove the factory-installed labels from the drive or cover them with additional labels. Removal voids the warranty. Some factory-installed labels contain information needed to service the drive. Other labels are used to seal out dirt and contamination.

3.2 Configuring the drive

Each drive on the Serial ATA interface connects point-to-point with the Serial ATA host adapter. There is no master/slave relationship because each drive is considered a master in a point-to-point relationship. If two drives are attached on one Serial ATA host adapter, the host operating system views the two devices as if they were both “masters” on two separate ports. Both drives behave as if they are Device 0 (master) devices.

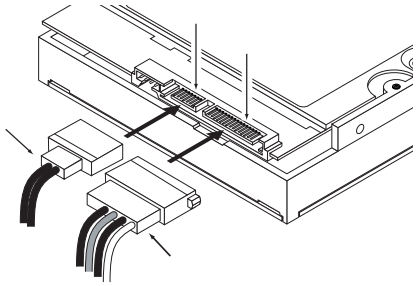
3.3 Serial ATA cables and connectors

The Serial ATA interface cable consists of four conductors in two differential pairs, plus three ground connections. The cable size may be 30 to 26 AWG with a maximum length of one meter (39.37 inches). See Table 8 for connector pin definitions. Either end of the SATA signal cable can be attached to the drive or host.

For direct backplane connection, the drive connectors are inserted directly into the host receptacle. The drive and the host receptacle incorporate features that enable the direct connection to be hot pluggable and blind mateable.

For installations which require cables, you can connect the drive as illustrated in Figure 3.

Figure 3. Attaching SATA cabling



Each cable is keyed to ensure correct orientation. SV35 Series SATA drives support latching SATA connectors.

3.4 Drive mounting

You can mount the drive in any orientation using four screws in the side-mounting holes or four screws in the bottom-mounting holes. See Figure 4 for drive mounting dimensions. Follow these important mounting precautions when mounting the drive:

- Allow a minimum clearance of 0.030 inches (0.76mm) around the entire perimeter of the drive for cooling.
- Use only 6-32 UNC mounting screws.
- The screws should be inserted no more than 0.150 inch (3.81mm) into the bottom or side mounting holes.
- Do not overtighten the mounting screws (maximum torque: 6 inch-lb).

Figure 4. Mounting dimensions (2TB and 1TB)

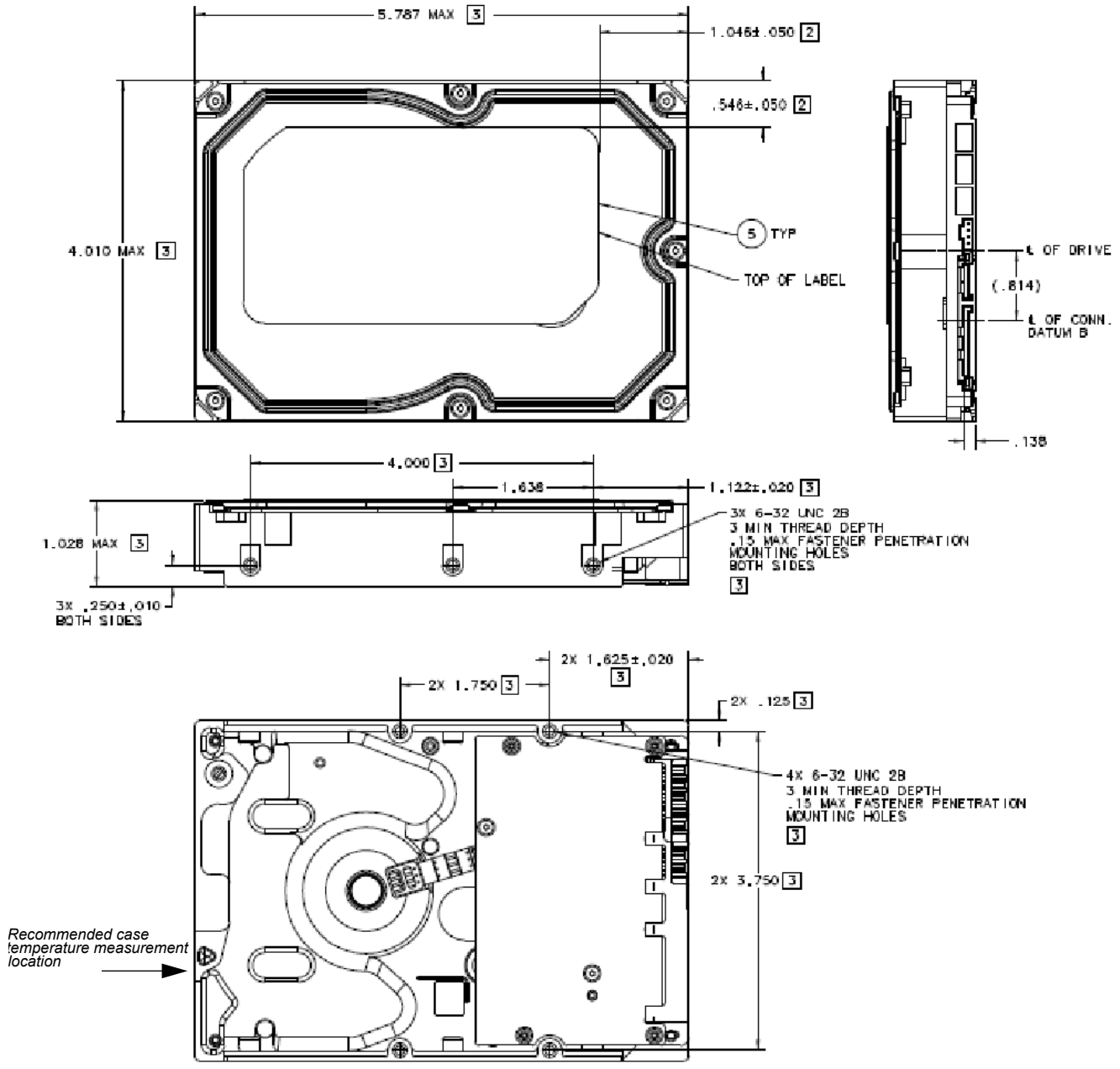
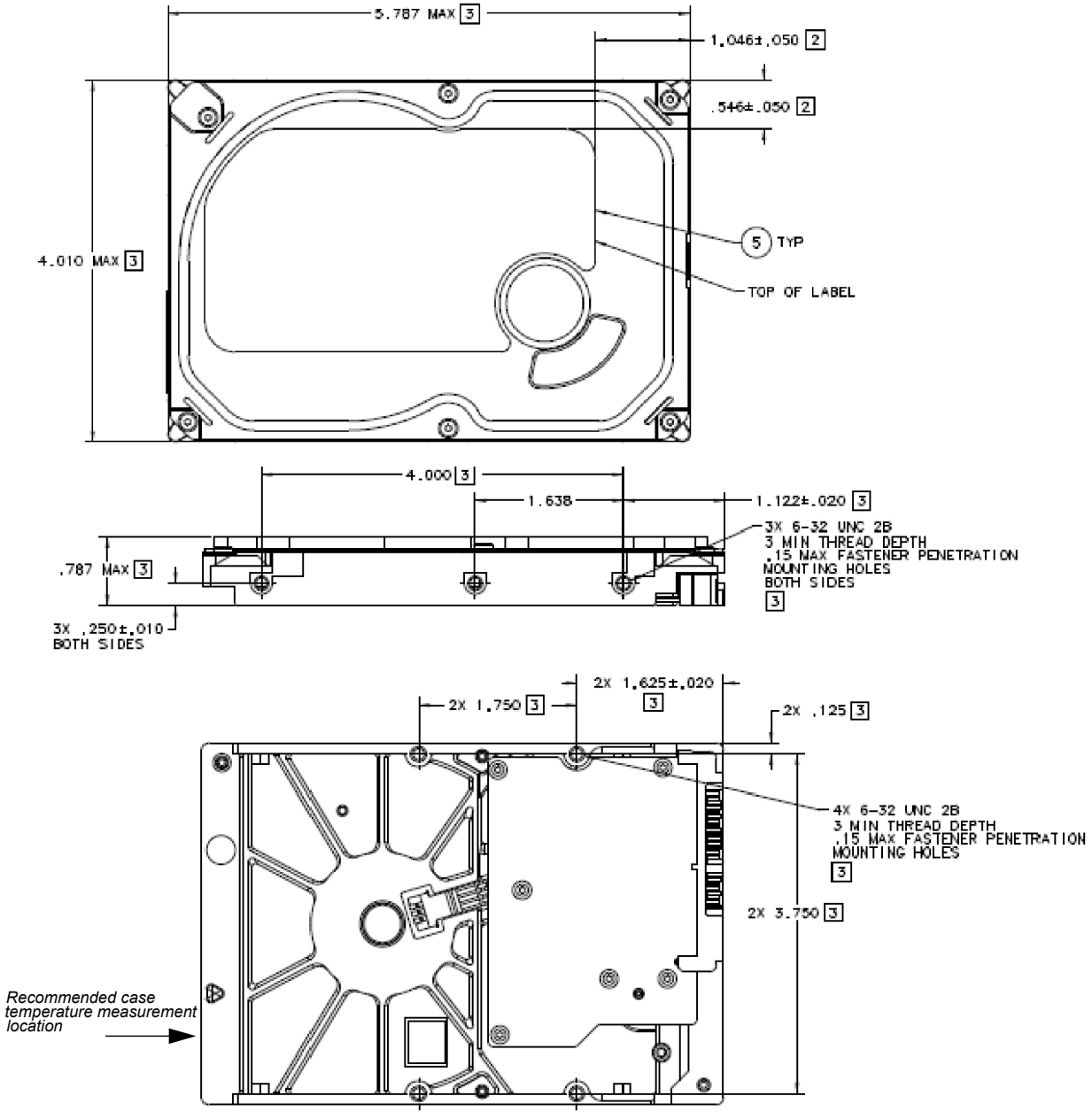


Figure 5. Mounting dimensions (500GB and 250GB)



4.0 Serial ATA (SATA) interface

These drives use the industry-standard Serial ATA interface that supports FIS data transfers. It supports ATA programmed input/output (PIO) modes 0–4; multiword DMA modes 0–2, and Ultra DMA modes 0–6.

For detailed information about the Serial ATA interface, refer to the “Serial ATA: High Speed Serialized AT Attachment” specification.

4.1 Hot-Plug compatibility

SV35 Series SATA drives incorporate connectors which enable you to hot plug these drives in accordance with the Serial ATA Revision 3.0 specification. This specification can be downloaded from www.serialata.org.

4.2 Serial ATA device plug connector pin definitions

Table 8 summarizes the signals on the Serial ATA interface and power connectors.

Table 8: Serial ATA connector pin definitions

Segment	Pin	Function	Definition
Signal	S1	Ground	2nd mate
	S2	A+	Differential signal pair A from Phy
	S3	A-	
	S4	Ground	2nd mate
	S5	B-	Differential signal pair B from Phy
	S6	B+	
	S7	Ground	2nd mate
Key and spacing separate signal and power segments			
Power	P1	V_{33}	3.3V power
	P2	V_{33}	3.3V power
	P3	V_{33}	3.3V power, pre-charge, 2nd mate
	P4	Ground	1st mate
	P5	Ground	2nd mate
	P6	Ground	2nd mate
	P7	V_5	5V power, pre-charge, 2nd mate
	P8	V_5	5V power
	P9	V_5	5V power
	P10	Ground	2nd mate
	P11	Ground or LED signal	If grounded, drive does not use deferred spin
	P12	Ground	1st mate.
	P13	V_{12}	12V power, pre-charge, 2nd mate
	P14	V_{12}	12V power
	P15	V_{12}	12V power

Notes:

1. All pins are in a single row, with a 1.27 mm (0.050”) pitch.
2. The comments on the mating sequence apply to the case of backplane blindmate connector only. In this case, the mating sequences are:
   - the ground pins P4 and P12.
   - the pre-charge power pins and the other ground pins.
   - the signal pins and the rest of the power pins.
3. There are three power pins for each voltage. One pin from each voltage is used for pre-charge when installed in a blind-mate backplane configuration.
4. All used voltage pins (V_x) must be terminated.

4.3 Supported ATA commands

The following table lists standard ATA and SATA commands that the drive supports.

For a detailed description of the ATA commands, refer to Information technology -AT Attachment 8 - ATA/ATAPI Command Set (ATA8-ACS) (www.t13.org) and Serial ATA International Organization: Serial ATA Revision 3.0 (http:// www.sata-io.org). See “S.M.A.R.T. commands” on page 34 for details and subcommands used in the S.M.A.R.T. implementation.

Table 9: Supported ATA commands

Command name	Command code (in hex)
Check Power Mode	$E5_H$
Device Configuration Freeze Lock	$B1_H$ / $C1_H$
Device Configuration Identify	$B1_H$ / $C2_H$
Device Configuration Restore	$B1_H$ / $C0_H$
Device Configuration Set	$B1_H$ / $C3_H$
Device Reset	08_H
Download Microcode	92_H
Execute Device Diagnostics	90_H
Flush Cache	$E7_H$
Flush Cache Extended	EA_H
Format Track	50_H
Identify Device	EC_H
Idle	$E3_H$
Idle Immediate	$E1_H$
Initialize Device Parameters	91_H
Read Buffer	$E4_H$
Read DMA	$C8_H$
Read DMA Extended	25_H
Read DMA Without Retries	$C9_H$
Read Log Ext	$2F_H$
Read Multiple	$C4_H$
Read Multiple Extended	29_H
Read Native Max Address	$F8_H$
Read Native Max Address Extended	27_H
Read Sectors	20_H
Read Sectors Extended	24_H
Read Sectors Without Retries	21_H
Read Verify Sectors	40_H
Read Verify Sectors Extended	42_H
Read Verify Sectors Without Retries	41_H
Recalibrate	10_H
Security Disable Password	$F6_H$

Command name	Command code (in hex)
Security Erase Prepare	$F3_H$
Security Erase Unit	$F4_H$
Security Freeze	$F5_H$
Security Set Password	$F1_H$
Security Unlock	$F2_H$
Seek	70_H
Set Features	EF_H
Set Max Address Note: Individual Set Max Address commands are identified by the value placed in the Set Max Features register as defined to the right.	$F9_H$ Address: 00_H Password: 01_H Lock: 02_H Unlock: 03_H Freeze Lock: 04_H
Set Max Address Extended	37_H
Set Multiple Mode	$C6_H$
Sleep	$E6_H$
S.M.A.R.T. Disable Operations	$B0_H$ / $D9_H$
S.M.A.R.T. Enable/Disable Autosave	$B0_H$ / $D2_H$
S.M.A.R.T. Enable Operations	$B0_H$ / $D8_H$
S.M.A.R.T. Execute Offline	$B0_H$ / $D4_H$
S.M.A.R.T. Read Attribute Thresholds	$B0_H$ / $D1_H$
S.M.A.R.T. Read Data	$B0_H$ / $D0_H$
S.M.A.R.T. Read Log Sector	$B0_H$ / $D5_H$
S.M.A.R.T. Return Status	$B0_H$ / DA_H
S.M.A.R.T. Save Attribute Values	$B0_H$ / $D3_H$
S.M.A.R.T. Write Log Sector	$B0_H$ / $D6_H$
Standby	$E2_H$
Standby Immediate	$E0_H$
Write Buffer	$E8_H$
Write DMA	CA_H
Write DMA Extended	35_H
Write DMA FUA Extended	CD_H
Write DMA Without Retries	CB_H
Write Log Extended	$3F_H$
Write Multiple	$C5_H$
Write Multiple Extended	39_H
Write Multiple FUA Extended	CE_H
Write Sectors	30_H
Write Sectors Without Retries	31_H
Write Sectors Extended	34_H
Write Uncorrectable	45_H

4.3.1 Identify Device command

The Identify Device command (command code EC_H) transfers information about the drive to the host following power up. The data is organized as a single 512-byte block of data, whose contents are shown in Table 9 on page 27. All reserved bits or words should be set to zero. Parameters listed with an “x” are drive-specific or vary with the state of the drive.

The following commands contain drive-specific features that may not be included in the Serial ATA specification.

Table 10: Identify Device commands

Word	Description	Value
0	Configuration information: • Bit 15: 0 = ATA; 1 = ATAPI • Bit 7: removable media • Bit 6: removable controller • Bit 0: reserved	$0C5A_H$
1	Number of logical cylinders	16,383
2	ATA-reserved	0000_H
3	Number of logical heads	16
4	Retired	0000_H
5	Retired	0000_H
6	Number of logical sectors per logical track: 63	$003F_H$
7–9	Retired	0000_H
10–19	Serial number: (20 ASCII characters, 0000_H = none)	ASCII
20	Retired	0000_H
21	Retired	0400_H
22	Obsolete	0000_H
23–26	Firmware revision (8 ASCII character string, padded with blanks to end of string)	x.xx
27–46	Drive model number: (40 ASCII characters, padded with blanks to end of string)	
47	(Bits 7–0) Maximum sectors per interrupt on Read multiple and Write multiple (16)	8010_H
48	Reserved	0000_H
49	Standard Standby timer, IORDY supported and may be disabled	$2F00_H$
50	ATA-reserved	0000_H
51	PIO data-transfer cycle timing mode	0200_H
52	Retired	0200_H
53	Words 54–58, 64–70 and 88 are valid	0007_H
54	Number of current logical cylinders	$xxxx_H$
55	Number of current logical heads	$xxxx_H$
56	Number of current logical sectors per logical track	$xxxx_H$
57–58	Current capacity in sectors	$xxxx_H$
59	Number of sectors transferred during a Read Multiple or Write Multiple command	$xxxx_H$

Table 10: Identify Device commands

Word	Description	Value
60–61	Total number of user-addressable LBA sectors available (see Section 2.2 for related information) *Note: The maximum value allowed in this field is: 0FFFFFFFh (268,435,455 sectors, 137 Gbytes). Drives with capacities over 137 Gbytes will have 0FFFFFFFh in this field and the actual number of user-addressable LBAs specified in words 100-103. This is required for drives that support the 48-bit addressing feature.	0FFFFFFFh*
62	Retired	0000_H
63	Multiword DMA active and modes supported (see note following this table)	$xx07_H$
64	Advanced PIO modes supported (modes 3 and 4 supported)	0003_H
65	Minimum multiword DMA transfer cycle time per word (120 nsec)	0078_H
66	Recommended multiword DMA transfer cycle time per word (120 nsec)	0078_H
67	Minimum PIO cycle time without IORDY flow control (240 nsec)	$00F0_H$
68	Minimum PIO cycle time with IORDY flow control (120 nsec)	0078_H
69–74	ATA-reserved	0000_H
75	Queue depth	0000_H
76	Serial ATA capabilities	$xxxx_H$
77	Reserved for future Serial ATA definition	$xxxx_H$
78	Serial ATA features supported	$xxxx_H$
79	Serial ATA features enabled	$xxxx_H$
80	Major version number	$003E_H$
81	Minor version number	0000_H
82	Command sets supported	$364B_H$
83	Command sets supported	$7C03_H$
84	Command sets support extension (see description following this table)	4003_H See Word 108-111 note. (4003H = 0100000000000011 binary)
85	Command sets enabled	$30xx_H$
86	Command sets enabled	0001_H
87	Command sets enable extension	4000_H
88	Ultra DMA support and current mode (see note following this table)	$00A4_H$
89	Security erase time	$00A4_H$
90	Enhanced security erase time	0000_H
92	Master password revision code	$FFFE_H$
93	Hardware reset value	$xxxx_H$
95–99	ATA-reserved	0000_H
100–103	Total number of user-addressable LBA sectors available (see Section 2.2 for related information). These words are required for drives that support the 48-bit addressing feature. Maximum value: 0000FFFFFFFFFFFFh.	ST2000VX002 - 3,907,029,168 ST31000526SV - 1,953,525,168 ST31000525SV - 1,953,525,168 ST3500411SV - 976,773,168 ST3500410SV - 976,773,168 ST3250311SV - 488,397,168

Table 10: Identify Device commands

Word	Description	Value
104–107	ATA-reserved	0000_H
108–111	The mandatory value of the world wide name (WWN) for the drive. NOTE: This field is valid if word 84, bit 8 is set to 1 indicating 64-bit WWN support.	Each drive will have a unique value.
112–127	ATA-reserved	0000_H
128	Security status	0001_H
129–159	Seagate-reserved	$xxxx_H$
160–254	ATA-reserved	0000_H
255	Integrity word	$xxA5_H$

Note. Advanced Power Management (APM) and Automatic Acoustic Management (AAM) features are not supported

Note. See the bit descriptions below for words 63, 84, and 88 of the Identify Drive data.

Description (if bit is set to 1)		
	Bit	**Word 63**
	0	Multiword DMA mode 0 is supported.
	1	Multiword DMA mode 1 is supported.
	2	Multiword DMA mode 2 is supported.
	8	Multiword DMA mode 0 is currently active.
	9	Multiword DMA mode 1 is currently active.
	10	Multiword DMA mode 2 is currently active.
	Bit	**Word 84**
	0	SMART error logging is supported.
	1	SMART self-test is supported.
	2	Media serial number is supported.
	3	Media Card Pass Through Command feature set is supported.
	4	Streaming feature set is supported.
	5	GPL feature set is supported.
	6	WRITE DMA FUA EXT and WRITE MULTIPLE FUA EXT commands are supported.
	7	WRITE DMA QUEUED FUA EXT command is supported.
	8	64-bit World Wide Name is supported.
	9-10	Obsolete.
	11-12	Reserved for TLC.
	13	IDLE IMMEDIATE command with IUNLOAD feature is supported.
	14	Shall be set to 1.
	15	Shall be cleared to 0.
	Bit	**Word 88**
	0	Ultra DMA mode 0 is supported.
	1	Ultra DMA mode 1 is supported.

	2	Ultra DMA mode 2 is supported.
	3	Ultra DMA mode 3 is supported.
	4	Ultra DMA mode 4 is supported.
	5	Ultra DMA mode 5 is supported.
	6	Ultra DMA mode 6 is supported.
	8	Ultra DMA mode 0 is currently active.
	9	Ultra DMA mode 1 is currently active.
	10	Ultra DMA mode 2 is currently active.
	11	Ultra DMA mode 3 is currently active.
	12	Ultra DMA mode 4 is currently active.
	13	Ultra DMA mode 5 is currently active.
	14	Ultra DMA mode 6 is currently active.

4.3.2 Set Features command

This command controls the implementation of various features that the drive supports. When the drive receives this command, it sets BSY, checks the contents of the Features register, clears BSY and generates an interrupt. If the value in the register does not represent a feature that the drive supports, the command is aborted. Power-on default has the read look-ahead and write caching features enabled. The acceptable values for the Features register are defined as follows:

Table 11: Set Features command values

- 02_H Enable write cache *(default).*
- 03_H Set transfer mode (based on value in Sector Count register).
  Sector Count register values:
  - 00_H Set PIO mode to default (PIO mode 2).
  - 01_H Set PIO mode to default and disable IORDY (PIO mode 2).
  - 08_H PIO mode 0
  - 09_H PIO mode 1
  - $0A_H$ PIO mode 2
  - $0B_H$ PIO mode 3
  - $0C_H$ PIO mode 4 *(default)*
  - 20_H Multiword DMA mode 0
  - 21_H Multiword DMA mode 1
  - 22_H Multiword DMA mode 2
  - 40_H Ultra DMA mode 0
  - 41_H Ultra DMA mode 1
  - 42_H Ultra DMA mode 2
  - 43_H Ultra DMA mode 3
  - 44_H Ultra DMA mode 4
  - 45_H Ultra DMA mode 5
  - 46_H Ultra DMA mode 6
- 10_H Enable use of SATA features
- 55_H Disable read look-ahead (read cache) feature.
- 82_H Disable write cache
- 90_H Disable use of SATA features
- AA_H Enable read look-ahead (read cache) feature *(default).*
- $F1_H$ Report full capacity available

Note. At power-on, or after a hardware or software reset, the default values of the features are as indicated above.

4.3.3 S.M.A.R.T. commands

S.M.A.R.T. provides near-term failure prediction for disc drives. When S.M.A.R.T. is enabled, the drive monitors predetermined drive attributes that are susceptible to degradation over time. If self-monitoring determines that a failure is likely, S.M.A.R.T. makes a status report available to the host. Not all failures are predictable. S.M.A.R.T. predictability is limited to the attributes the drive can monitor. For more information on S.M.A.R.T. commands and implementation, see the *Draft ATA-5 Standard.*

SeaTools diagnostic software activates a built-in drive self-test (DST S.M.A.R.T. command for $D4_H$) that eliminates unnecessary drive returns. The diagnostic software ships with all new drives and is also available at: http://seatools.seagate.com.

This drive is shipped with S.M.A.R.T. features disabled. You must have a recent BIOS or software package that supports S.M.A.R.T. to enable this feature. The table below shows the S.M.A.R.T. command codes that the drive uses.

Table 12: S.M.A.R.T. commands

Code in features register	S.M.A.R.T. command
$D0_H$	S.M.A.R.T. Read Data
$D2_H$	S.M.A.R.T. Enable/Disable Attribute Autosave
$D3_H$	S.M.A.R.T. Save Attribute Values
$D4_H$	S.M.A.R.T. Execute Off-line Immediate (runs DST)
$D5_H$	S.M.A.R.T. Read Log Sector
$D6_H$	S.M.A.R.T. Write Log Sector
$D8_H$	S.M.A.R.T. Enable Operations
$D9_H$	S.M.A.R.T. Disable Operations
DA_H	S.M.A.R.T. Return Status

Note. If an appropriate code is not written to the Features Register, the command is aborted and 0*x*04 (abort) is written to the Error register.

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